

To avoid conflicts which can arise when two operations are to be performed at the same time, a control program in the HP87XM maintains an event queue. Each time an operation is performed, the control program computes the next time for its performance and places it in the queue. Some care must be used in scheduling events, however, because the computer allows only limited simultaneous operations. For instance, changes in the digits on port 10 of the BCD interface cannot be made while data are being read on one of the other BCD ports. Thus, if the back pressure regulators are to be switched at the same time a density reading is to be taken, a conflict can occur. It is a simple matter, however, to requeue any switching events to a time immediately after completion of density data collection and storage.

The serial interface is used solely to receive results of gas analyses from the HP5840 gas chromatograph. When the command is issued to start a GC run (BCD interface, port 10, digit 3), the control program also initiates a transfer operation from the serial interface to a buffer in the HP87XM. Data from the GC can then be received while other program operations are taking place. When the report from the GC is complete, it transmits an ETX character which signals to the control software that the data from the GC are ready to be processed. The control program then schedules the processing and storage of the GC data for a time when the HP87XM is not occupied with other operations.

The new control system eliminates most manual data entry into the computer programs which calculate phase compositions and plot run results, and eliminates the need for operator intervention during a run. The apparatus can now operate unattended. Liquid composition data can be transferred directly from the HP5880 gas chromatograph to the HP87XM, and reports and plots can be prepared and printed by the HP87XM. Performing data computations and plotting functions with the HP87XM have led to a sharp reduction in costs for central computer time. If desired, however, data can still be transferred to the central computer system for processing a backup data storage.



## APPENDIX B

### Compilation of Miscible Displacement Data

This appendix contains the effluent composition histories and their least error history match for all the miscible displacement experiments discussed in §4.4. The experiment numbers on each figure are the same experiment numbers as those in the body of the report (Tables 4.4 and 4.5). The symbols and terms used on these figures are:

$\beta$  = pulse size in pore volumes

$u$  = average interstitial velocity

$Pe$  = Peclet number,  $uL/D$ , where  $L$  is the core length

$D$  = dispersion coefficient

$a$  = Damköhler number,  $K_m L/u$

$K_m$  = mass transfer coefficient

Total error refers to the sum of the absolute values of the differences between the calculated and experimental data points

Air permeabilities were not corrected for Klinkenberg effect

The dead volume listed was the volume between the core outlet and the sample collector or on-line device for composition measurement. The dead volume was subtracted from the total fluid injected at any time to arrive at the time when the fluid of the measured composition arrived at the core outlet.

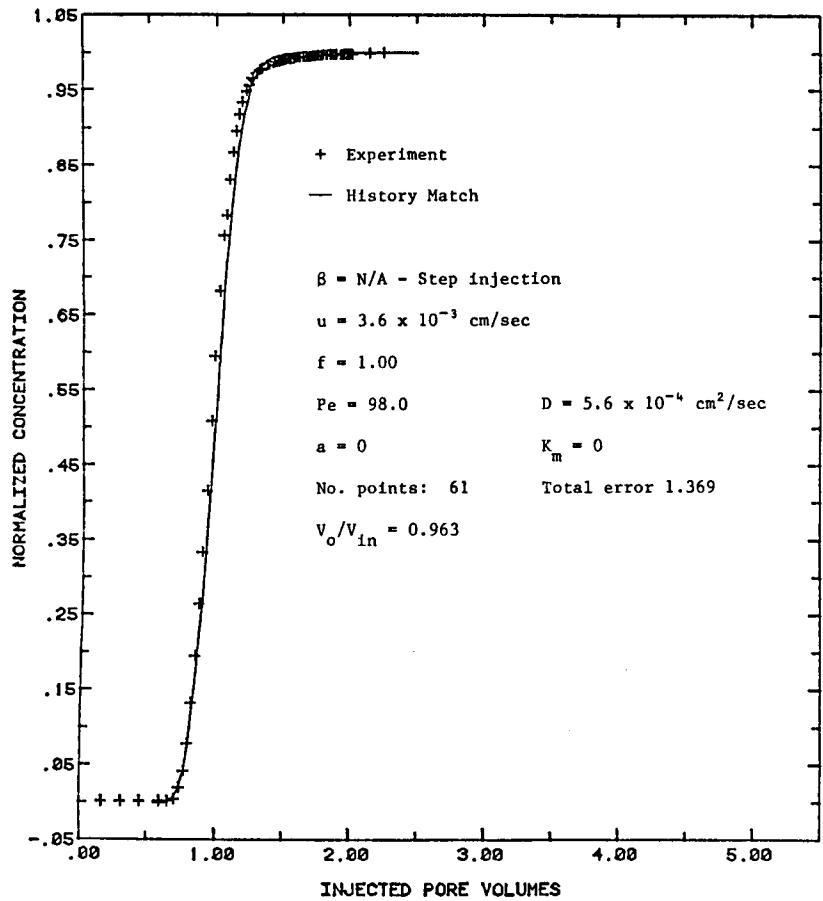


Fig. B.1 Experiment No. 1      Core: Berea  
 Length: 15.05 cm      Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$       Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: Ethylbenzene, ethylbutyrate  
 Dead volume:  $2.16 \text{ cm}^3$

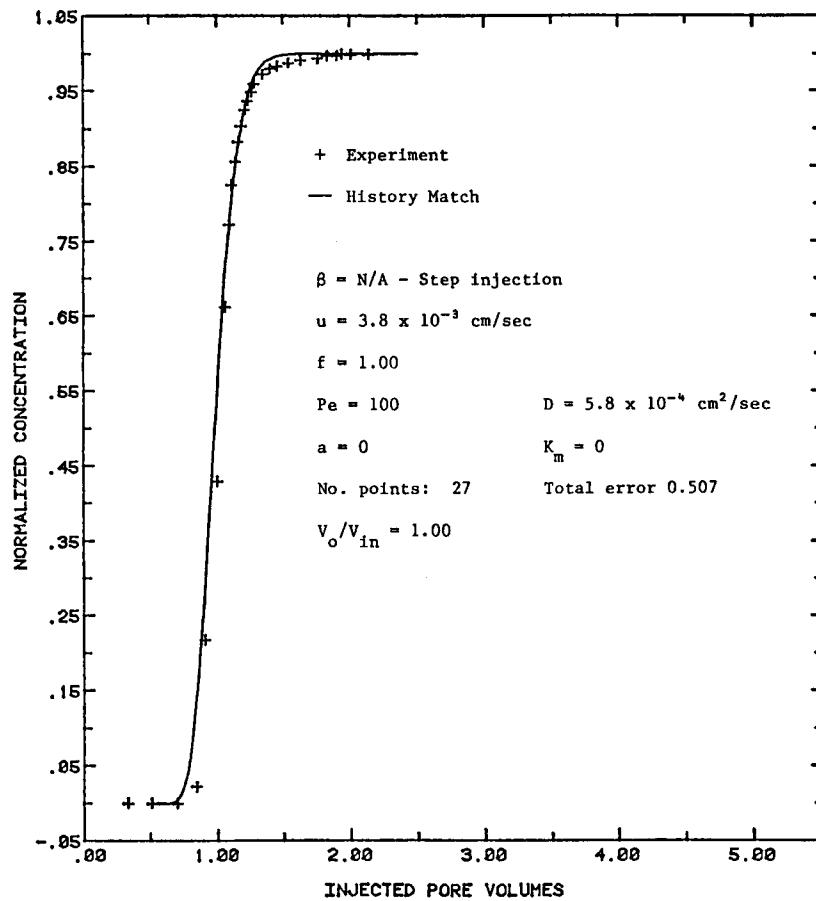


Fig. B.2 Experiment No. 2      Core: Berea  
 Length: 15.05 cm      Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$       Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: Ethylbenzene, ethylbutyrate  
 Dead volume:  $0.185 \text{ cm}^3$

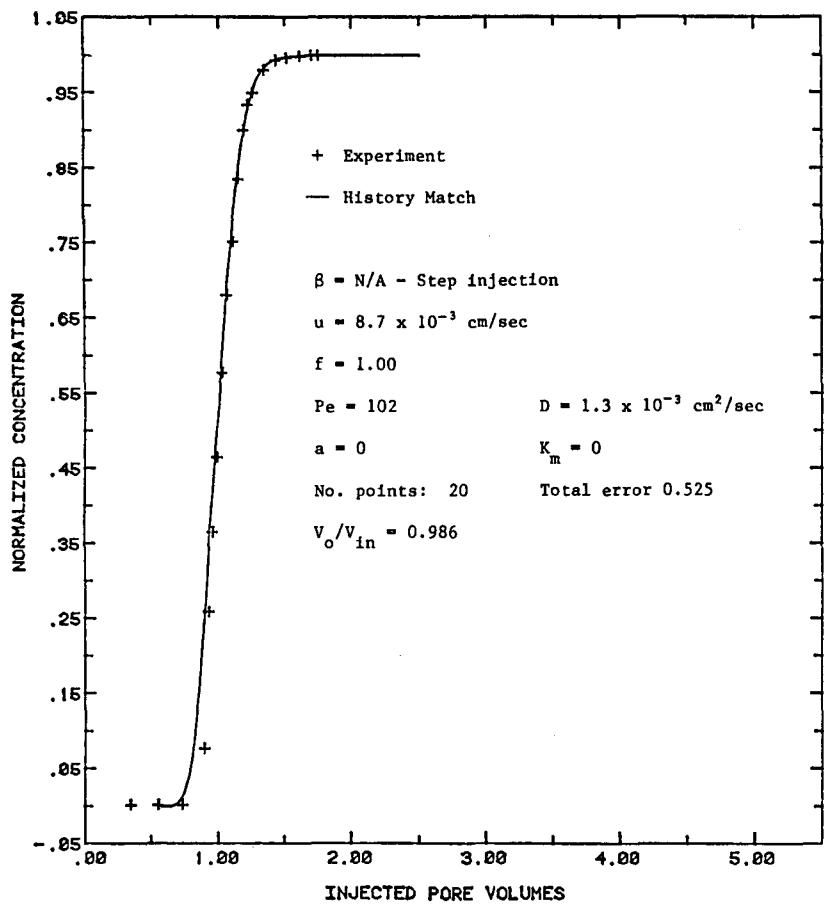


Fig. B.3 Experiment No. 3 Core: Berea  
 Length: 15.05 cm Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$  Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume:  $0.185 \text{ cm}^3$

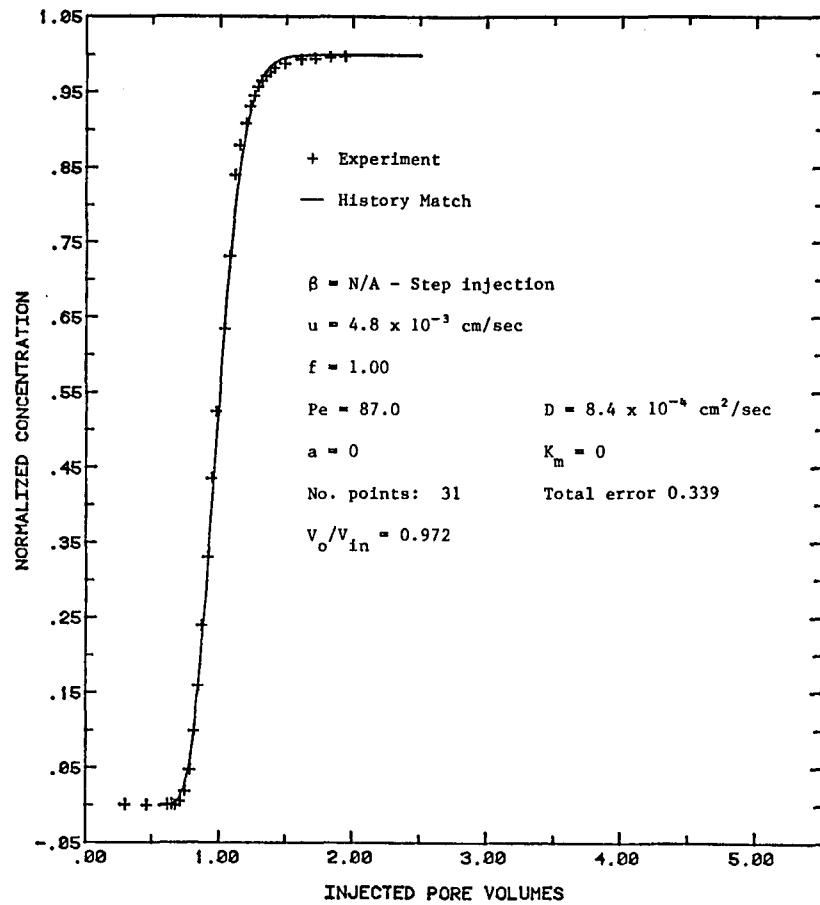


Fig. B.4 Experiment No. 4 Core: Berea  
 Length: 15.05 cm Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$  Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume:  $0.185 \text{ cm}^3$

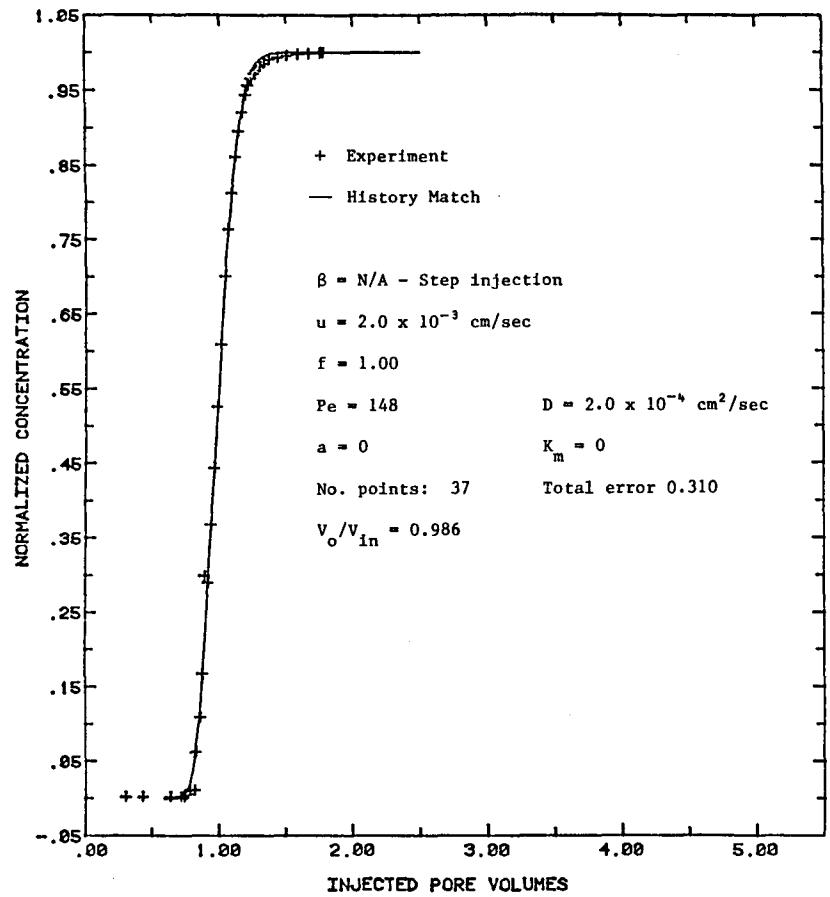


Fig. B.5 Experiment No. 5      Core: Berea  
 Length: 15.05 cm      Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$       Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume:  $0.185 \text{ cm}^3$

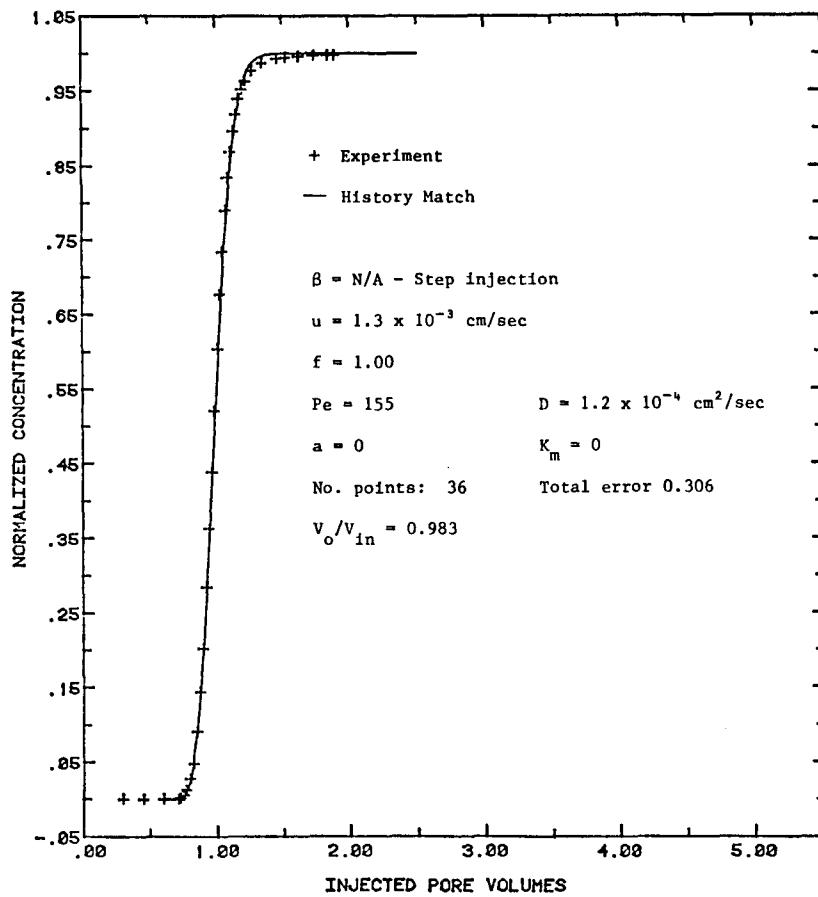


Fig. B.6 Experiment No. 6      Core: Berea  
 Length: 15.05 cm      Diameter: 3.81 cm  
 Pore volume:  $31.7 \text{ cm}^3$       Porosity: 18.4%  
 Air permeability: 180 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume:  $0.185 \text{ cm}^3$

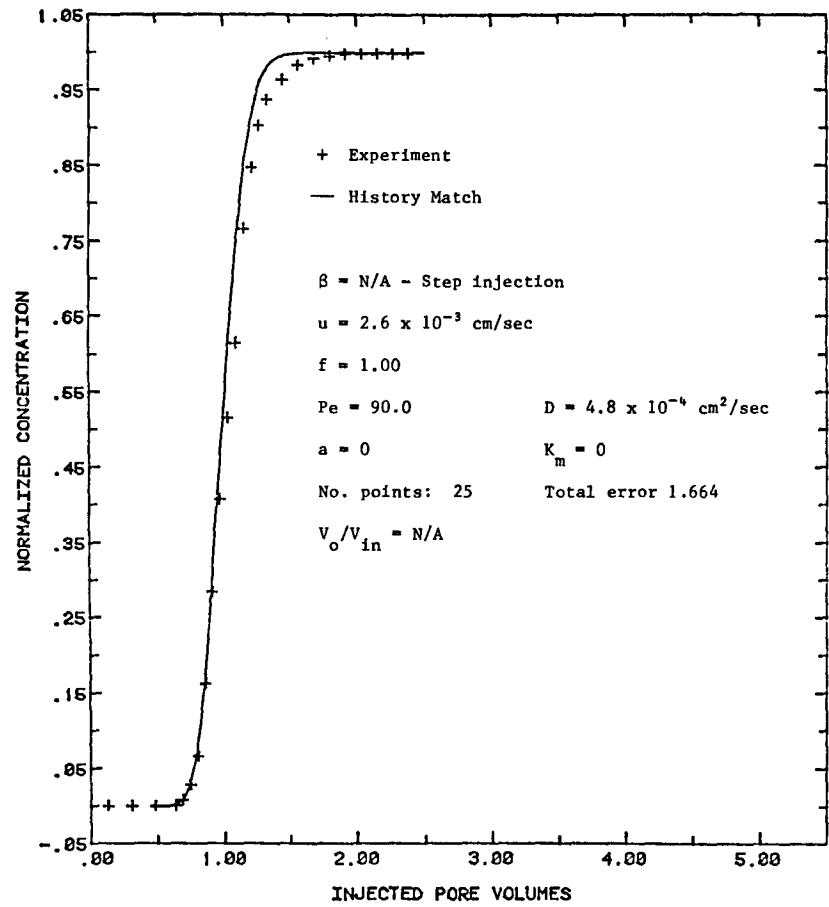


Fig. B.7 Experiment No. 7 Core: B-1  
Length: 13.9 cm Diameter: 3.81 cm  
Pore volume: 28.9  $\text{cm}^3$  Porosity: 18.2%  
Air permeability: 180 md  
Fluids: ethylbenzene/ethylbutyrate  
Dead volume: 0.40  $\text{cm}^3$

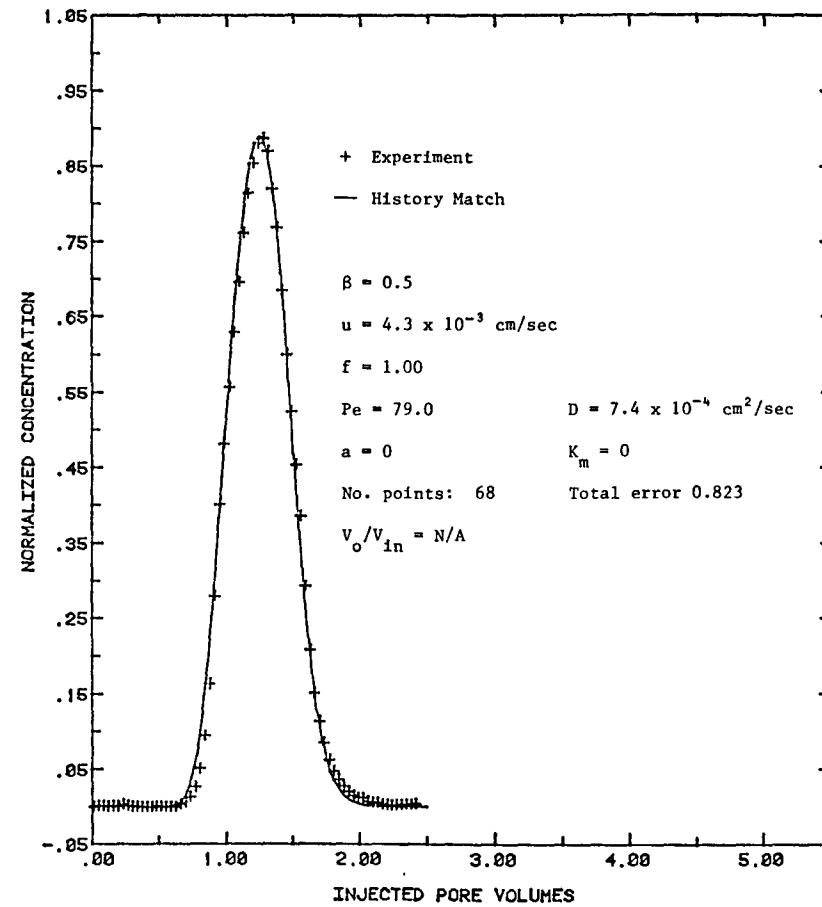


Fig. B.8 Experiment No. 8 Core: B-1  
Length: 13.6 cm Diameter: 3.81 cm  
Pore volume: 28.6  $\text{cm}^3$  Porosity: 18.2%  
Air permeability: 180 md  
Fluids: 2%/3% NaCl brine  
Dead volume: 0.40  $\text{cm}^3$

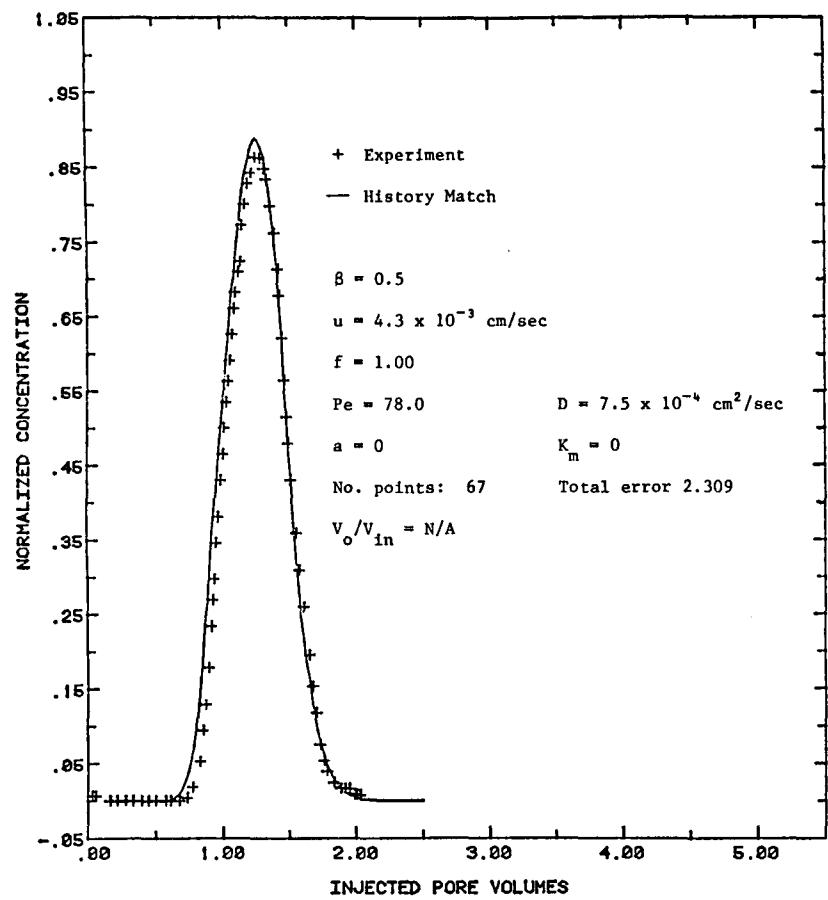


Fig. B.9 Experiment No. 9 Core: B-1  
Length: 13.6 cm Diameter: 3.81 cm  
Pore volume: 28.6  $\text{cm}^3$  Porosity: 18.2%  
Air permeability: 180 md  
Fluids:  $C_{10}/C_{11}$   
Dead volume: 0.40  $\text{cm}^3$

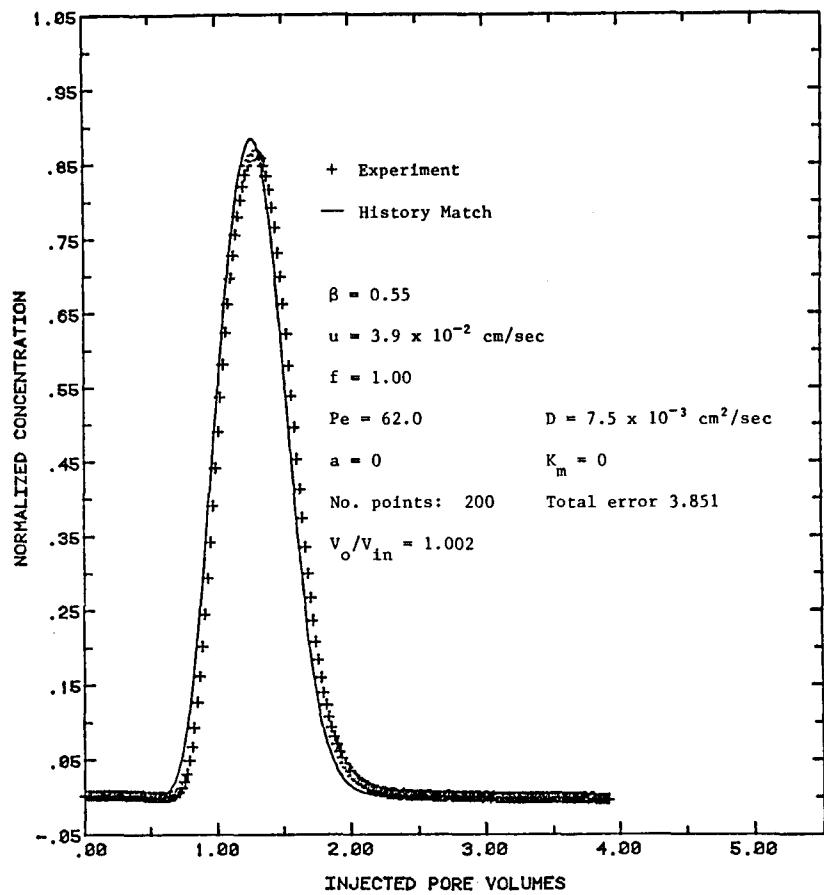


Fig. B.10 Experiment No. 10 Core: B-1/2  
Length: 12.07 cm Diameter: 1.27 cm  
Pore volume: 3.8  $\text{cm}^3$  Porosity: 25%  
Air permeability: 1000 md  
Fluids:  $C_{10}/C_{11}$   
Dead volume: 0.53  $\text{cm}^3$

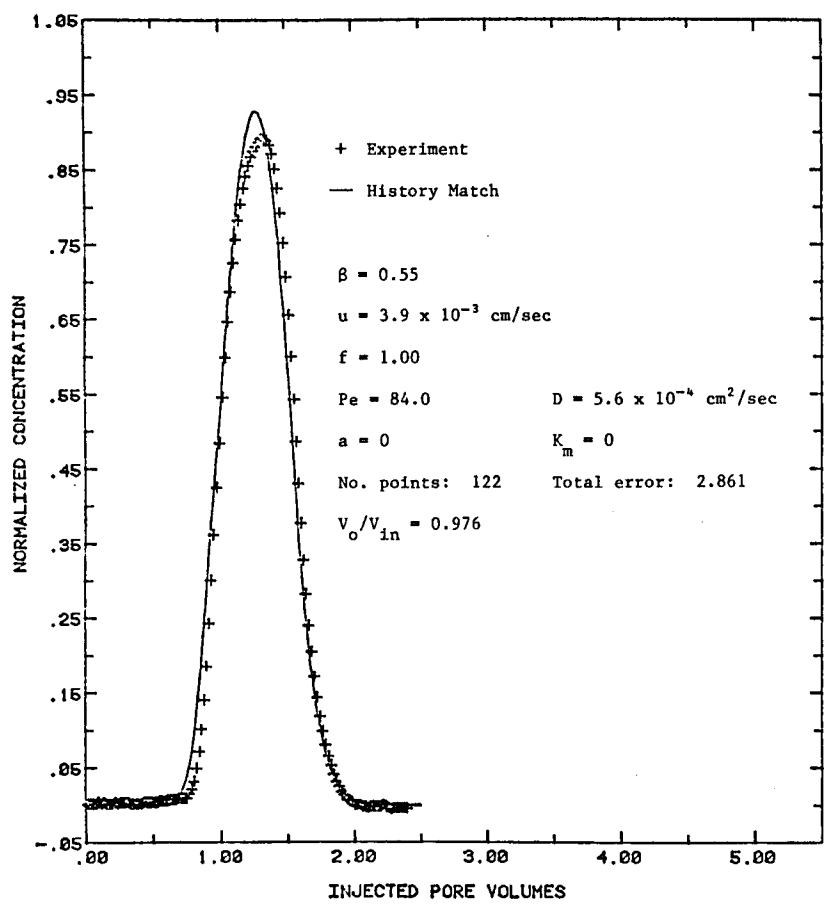


Fig. B.11 Experiment No. 11 Core: B-1/2  
Length: 12.07 cm Diameter: 1.27 cm  
Pore volume: 3.8 cm $^3$  Porosity: 25%  
Air permeability: 1000 md  
Fluids: C<sub>10</sub>/C<sub>11</sub>  
Dead volume: 0.53 cm $^3$

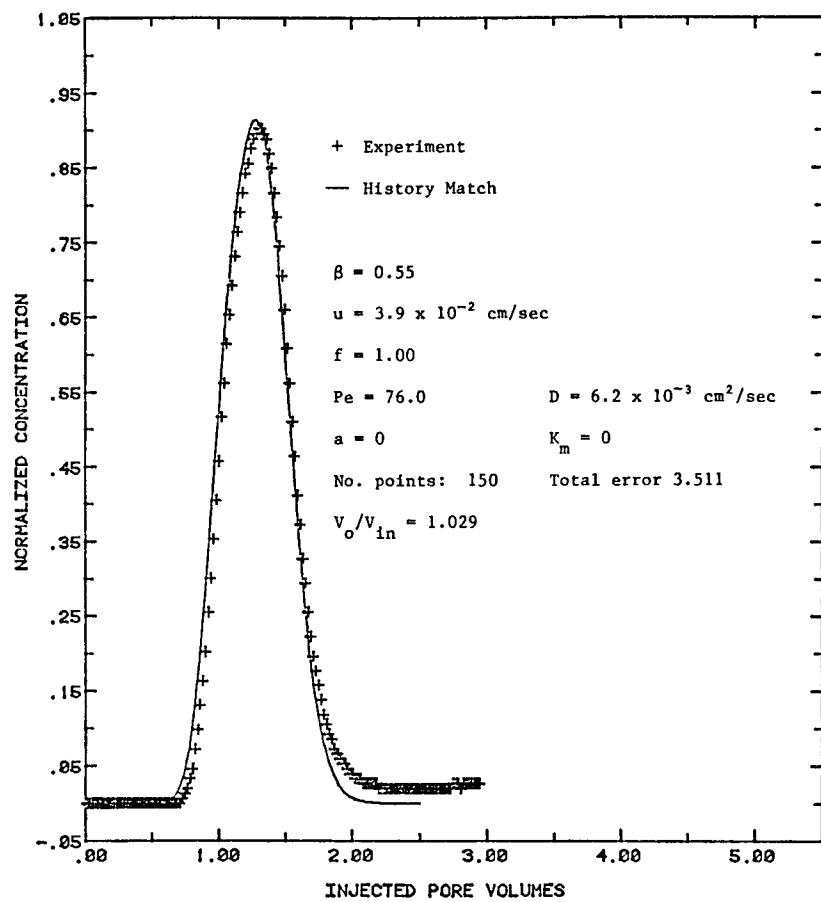


Fig. B.12 Experiment No. 12 Core: B-1/2  
Length: 12.07 cm Diameter: 1.27 cm  
Pore volume: 3.8 cm $^3$  Porosity: 25%  
Air permeability: 1000 md  
Fluids: 2%/3% NaCl brine  
Dead volume: 0.53 cm $^3$

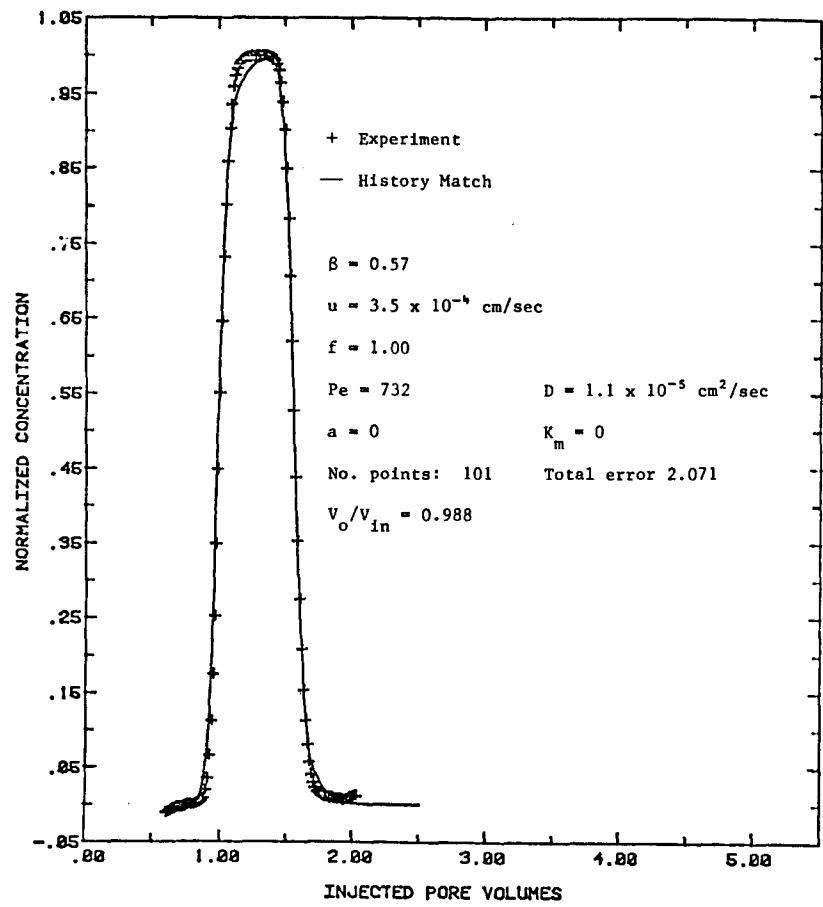


Fig. B.13 Experiment No. 13 Core: B-5/8  
Length: 22.1 cm Diameter: 1.59 cm  
Pore volume:  $9.25 \text{ cm}^3$  Porosity: 21.1%  
Air permeability: 500 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
Dead volume:  $0.33 \text{ cm}^3$

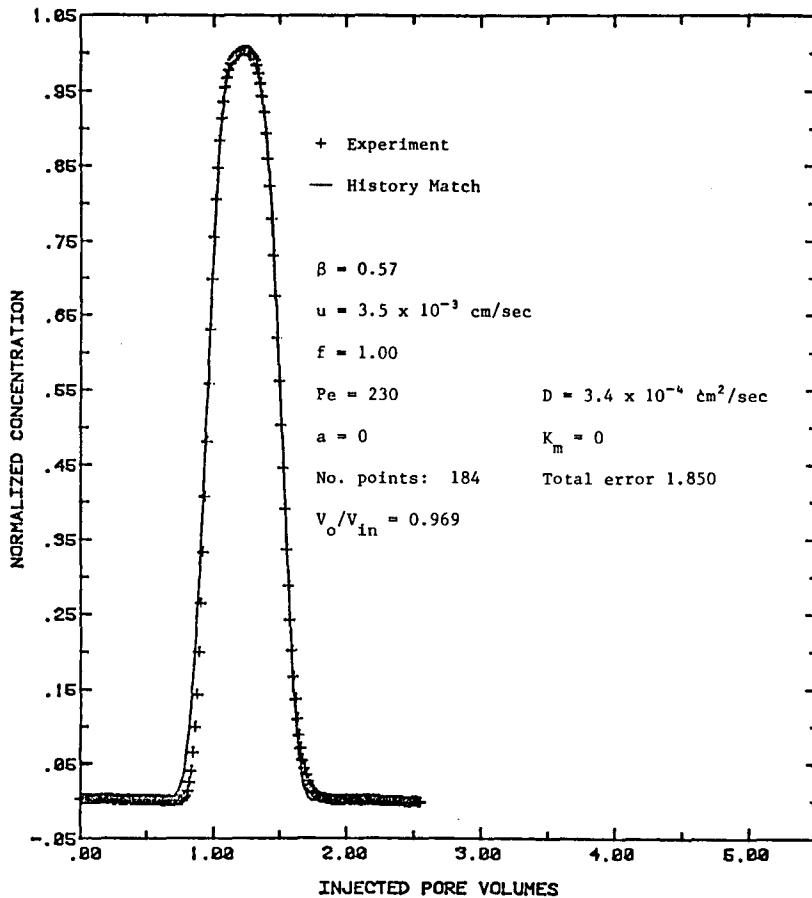


Fig. B.14 Experiment No. 14 Core: B-5/8  
Length: 22.1 cm Diameter: 1.59 cm  
Pore volume:  $9.25 \text{ cm}^3$  Porosity: 21.1%  
Air permeability: 500 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
Dead volume:  $0.33 \text{ cm}^3$

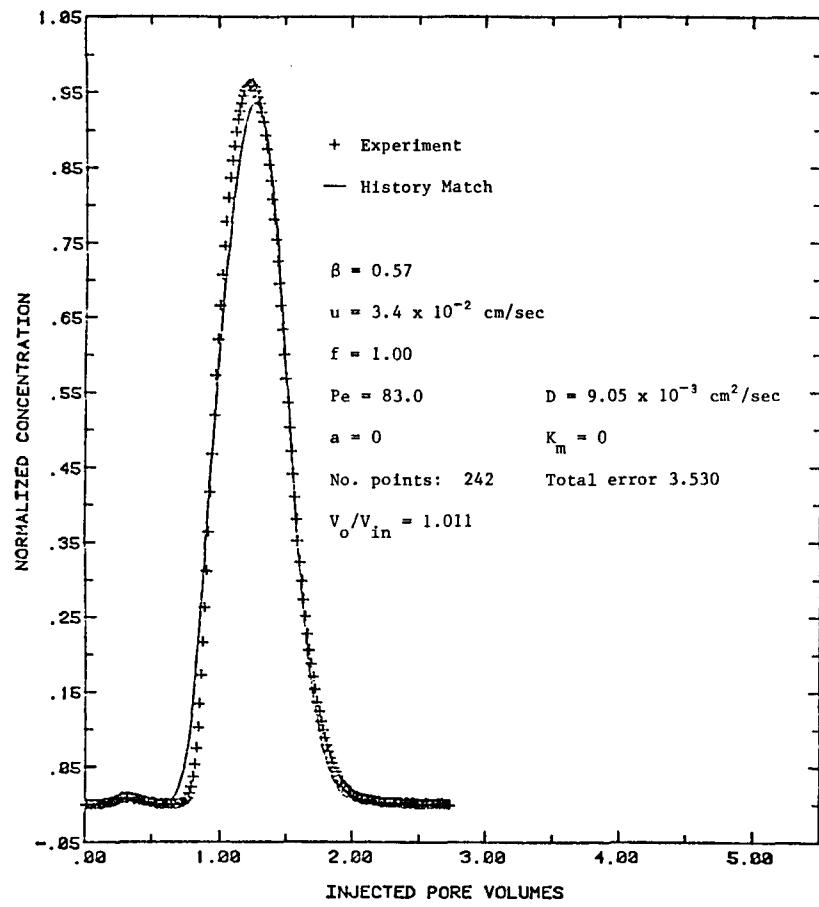


Fig. B.15   Experiment No. 15      Core: B-5/8  
 Length: 22.1 cm      Diameter: 1.59 cm  
 Pore volume:  $9.25 \text{ cm}^3$       Porosity: 21.1%  
 Air permeability: 500 md  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $0.33 \text{ cm}^3$

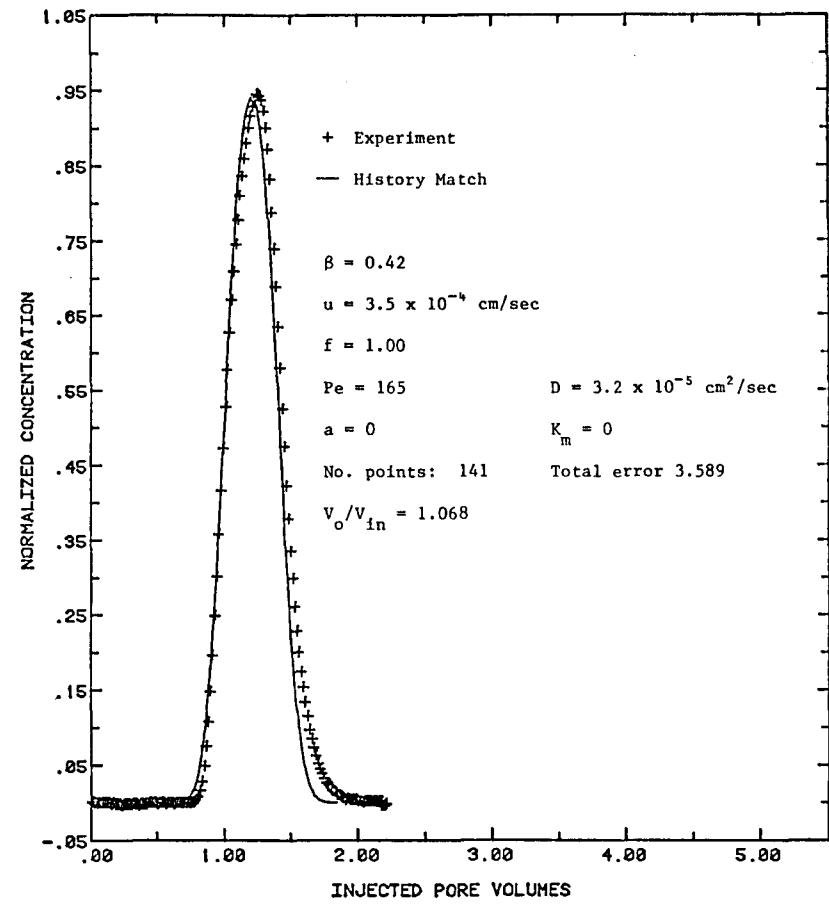


Fig. B.16   Experiment No. 16      Core: F-2  
 Length: 14.92 cm      Diameter: 3.81 cm  
 Pore volume:  $34.17 \text{ cm}^3$       Porosity: 20.1%  
 Air permeability: 380 md  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $1.1 \text{ cm}^3$

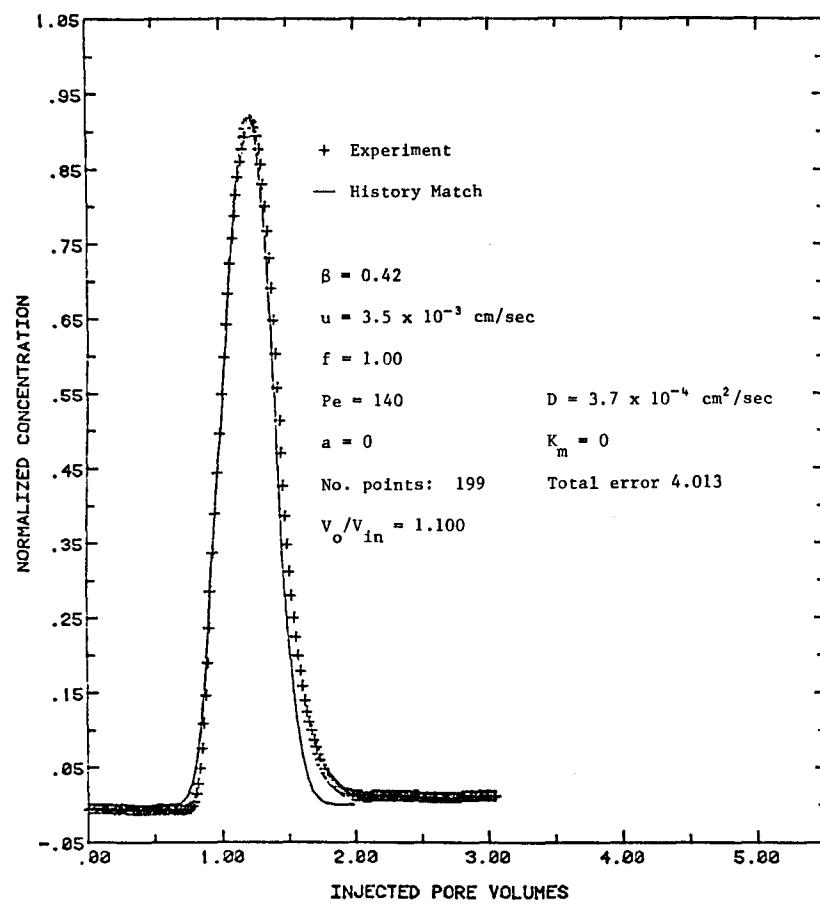


Fig. B.17 Experiment No. 17 Core: F-2  
Length: 14.92 cm Diameter: 3.81 cm  
Pore volume:  $34.17 \text{ cm}^3$  Porosity: 20.1%  
Air permeability: 380 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ -brine  
Dead volume:  $1.1 \text{ cm}^3$

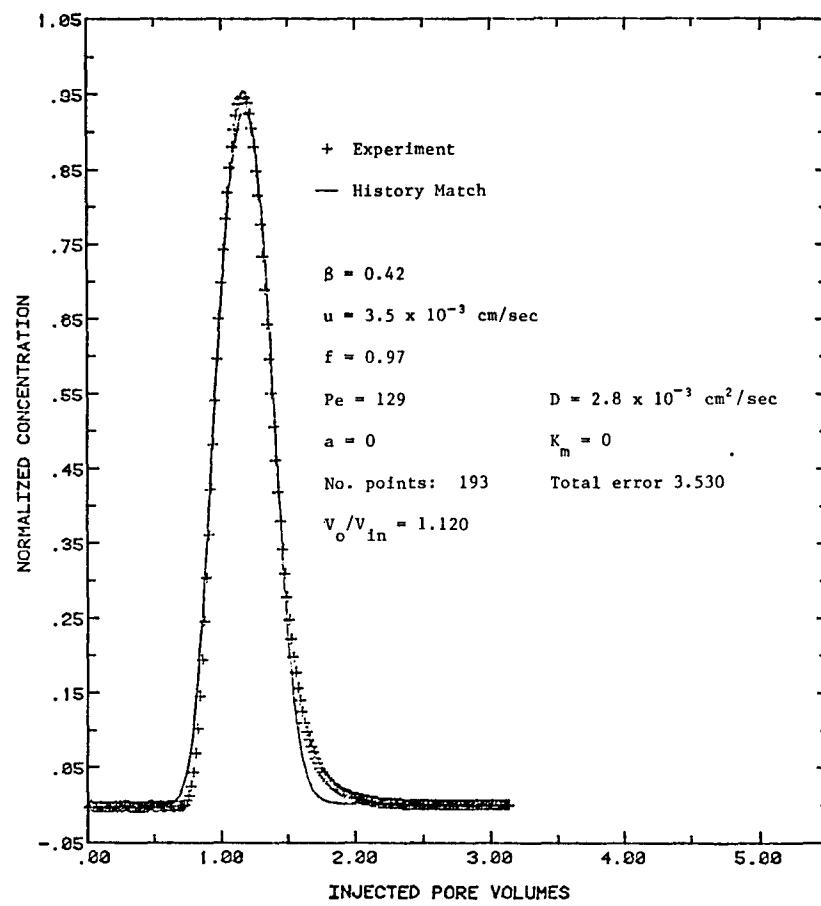


Fig. B.18 Experiment No. 18 Core: F-2  
Length: 14.92 cm Diameter: 3.81 cm  
Pore volume:  $34.17 \text{ cm}^3$  Porosity: 20.1%  
Air permeability: 380 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ -brine  
Dead volume:  $1.1 \text{ cm}^3$

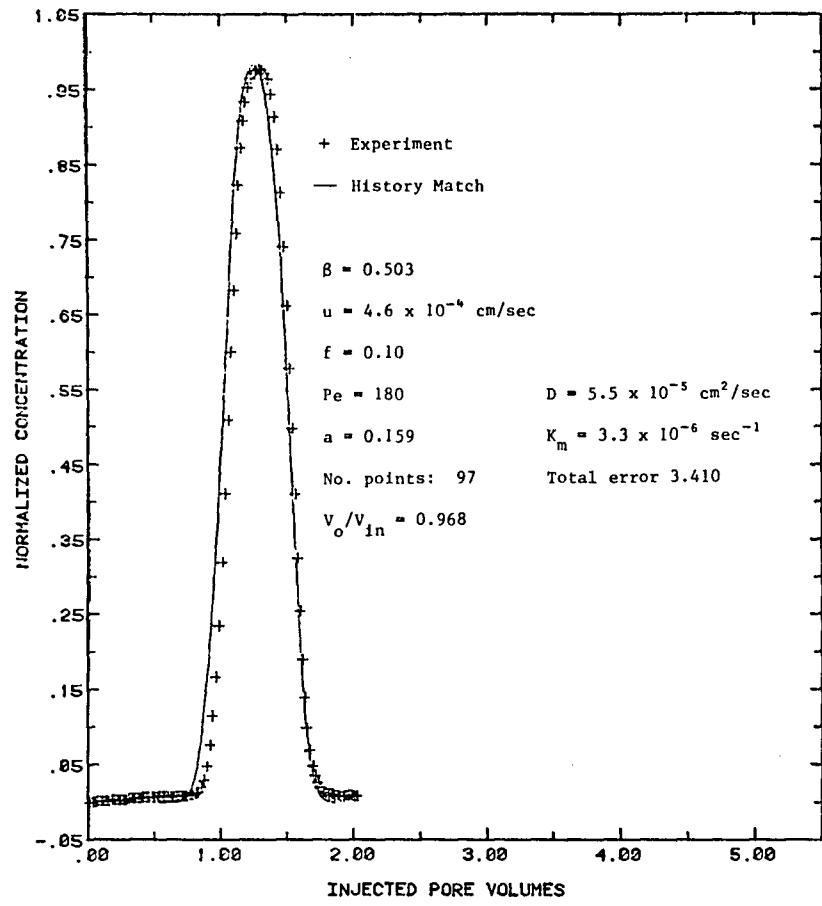


Fig. B.19 Experiment No. 19 Core: R-1  
 Length: 21.8 cm Diameter: 1.59 cm  
 Pore volume:  $10.55 \text{ cm}^3$  Porosity: 24.5%  
 Air permeability: N/A  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $0.365 \text{ cm}^3$

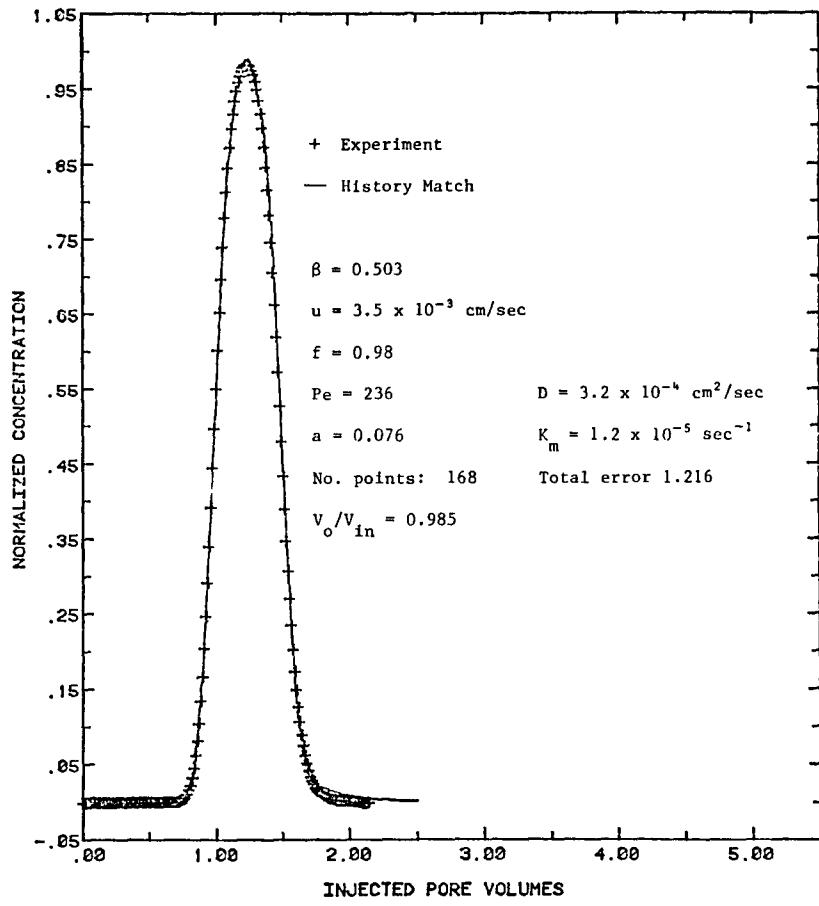


Fig. B.20 Experiment No. 20 Core: R-1  
 Length: 21.8 cm Diameter: 1.59 cm  
 Pore volume:  $10.55 \text{ cm}^3$  Porosity: 24.5%  
 Air permeability: N/A  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $0.365 \text{ cm}^3$

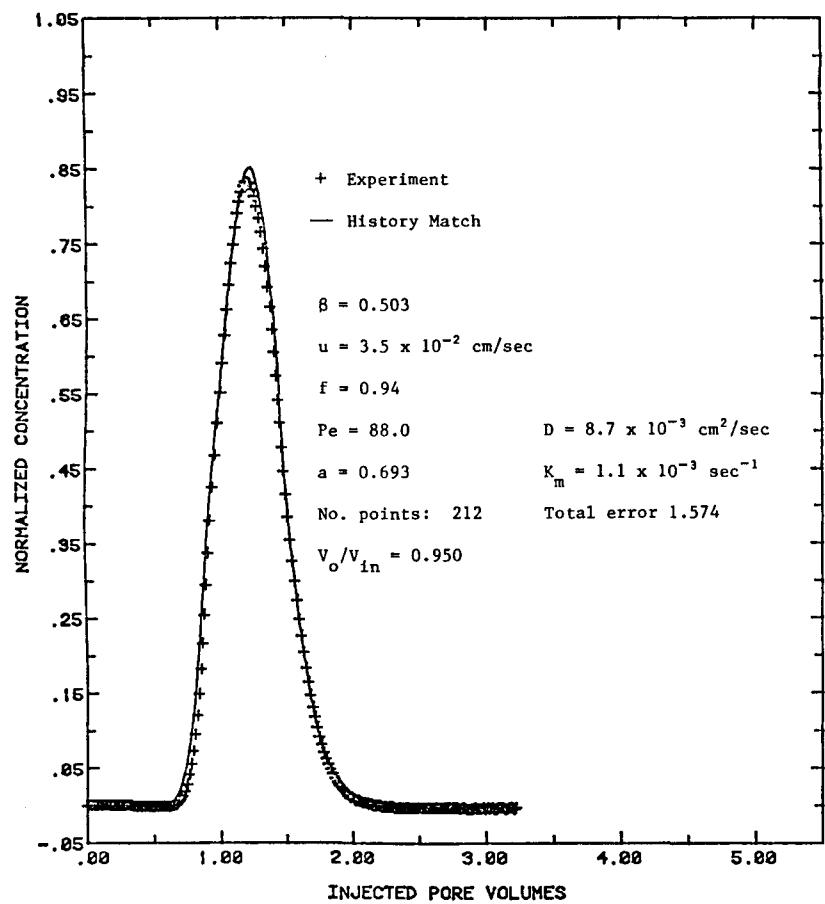


Fig. B.21 Experiment No. 21 Core: R-1  
 Length: 21.8 cm Diameter: 1.59 cm  
 Pore volume:  $10.55 \text{ cm}^3$  Porosity: 24.5%  
 Air permeability: N/A  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ -brine  
 Dead volume:  $0.365 \text{ cm}^3$

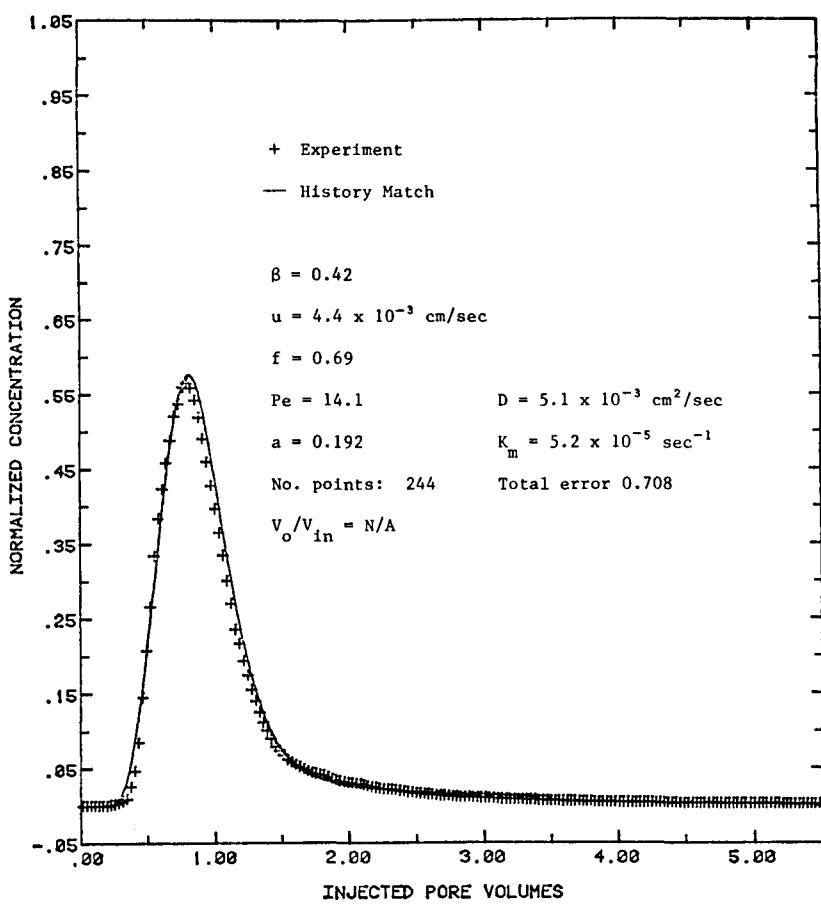


Fig. B.22 Experiment No. 22 Core: H-1  
 Length: 16.2 cm Diameter: 3.81 cm  
 Pore volume:  $33.7 \text{ cm}^3$  Porosity: 18.2%  
 Air permeability: 40 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume: N/A

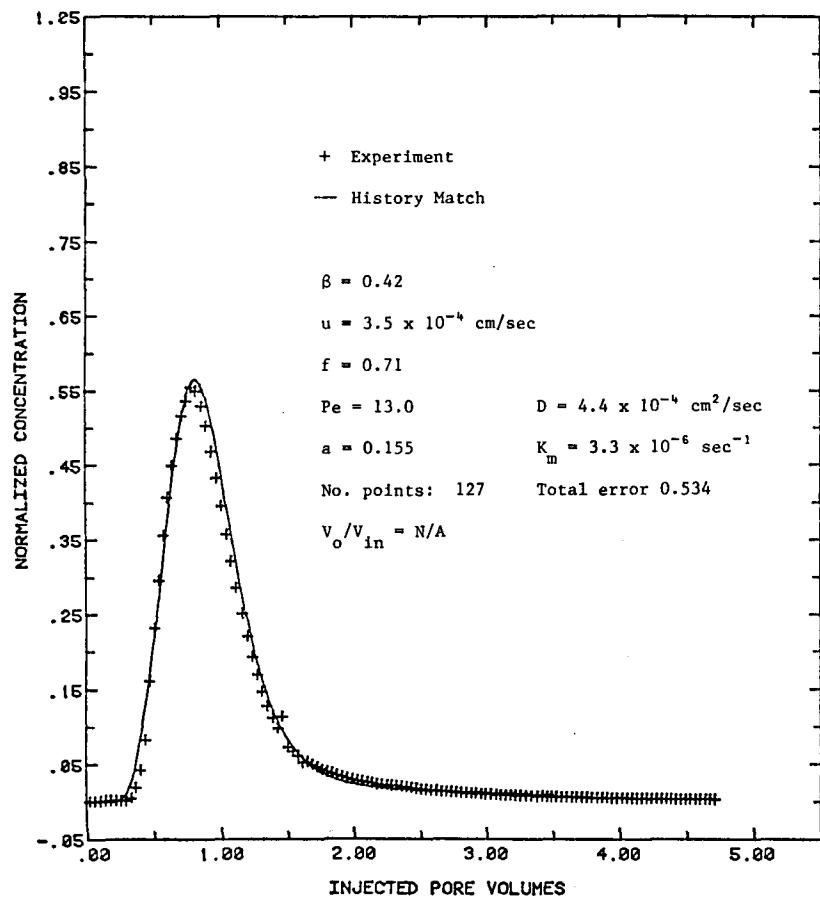


Fig. B.23    Experiment No. 23                   Core: H-1  
 Length: 16.2 cm                   Diameter: 3.81 cm  
 Pore volume:  $33.7 \text{ cm}^3$                    Porosity: 18.2%  
 Air permeability: 40 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume: N/A

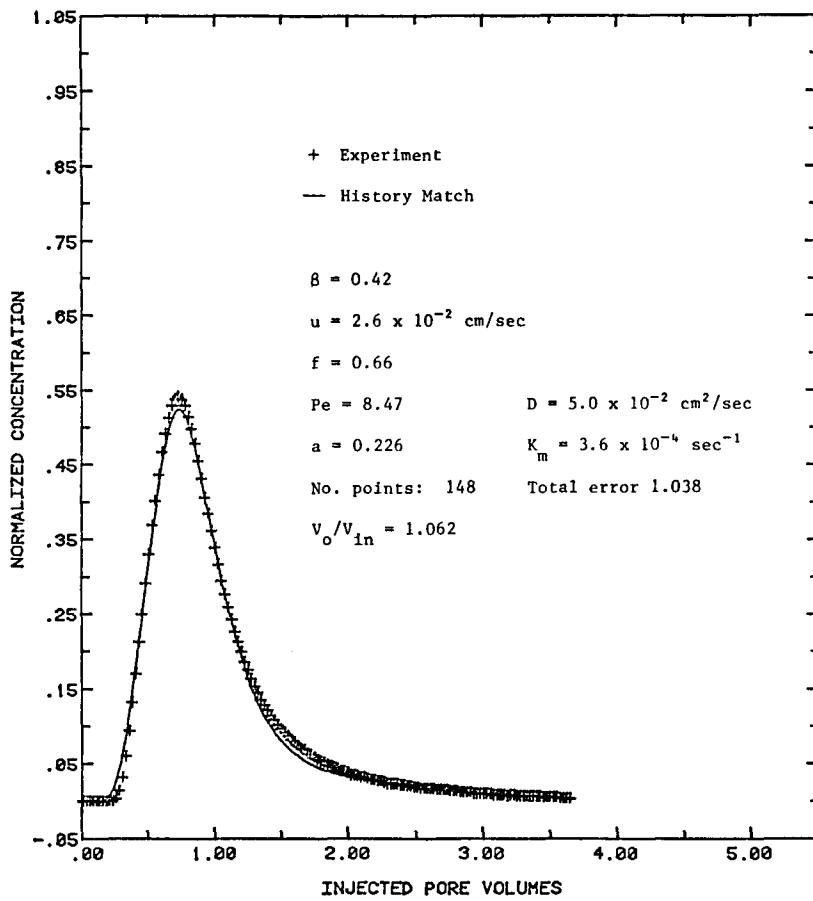


Fig. B.24    Experiment No. 24                   Core: H-1  
 Length: 16.2 cm                   Diameter: 3.81 cm  
 Pore volume:  $33.7 \text{ cm}^3$                    Porosity: 18.2%  
 Air permeability: 40 md  
 Fluids: 0.4%/0.52% sucrose in Cl<sup>-</sup>brine  
 Dead volume:  $0.85 \text{ cm}^3$

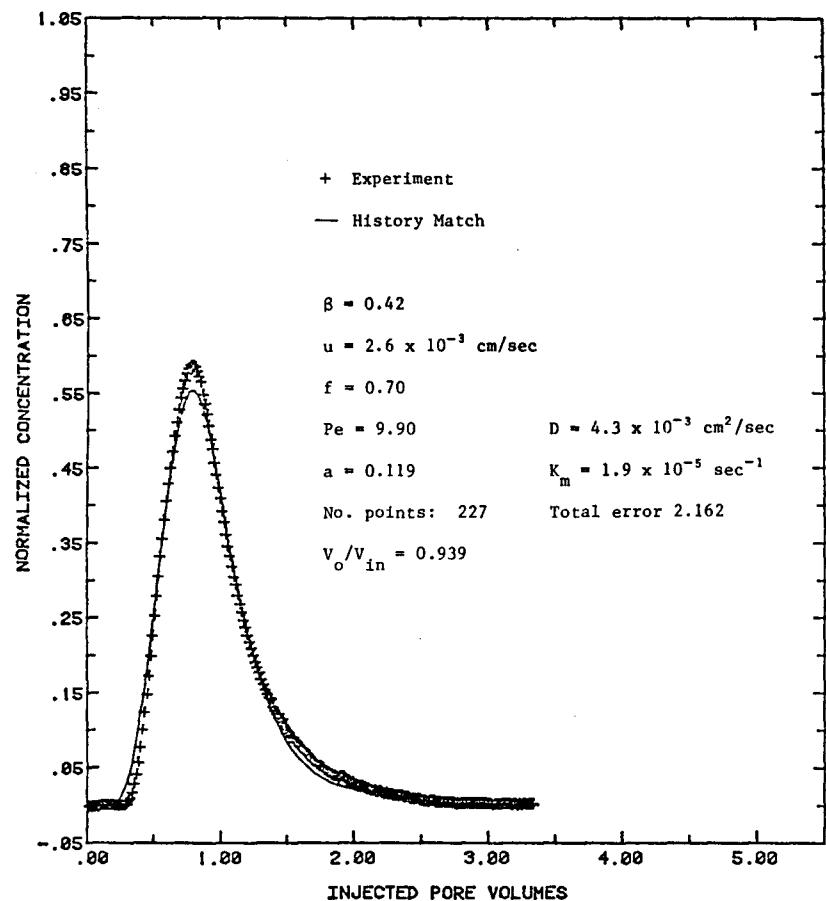


Fig. B.25 Experiment No. 25 Core: H-1  
Length: 16.2 cm Diameter: 3.81 cm  
Pore volume:  $33.7 \text{ cm}^3$  Porosity: 18.2%  
Air permeability: 40 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ -brine  
Dead volume:  $0.85 \text{ cm}^3$

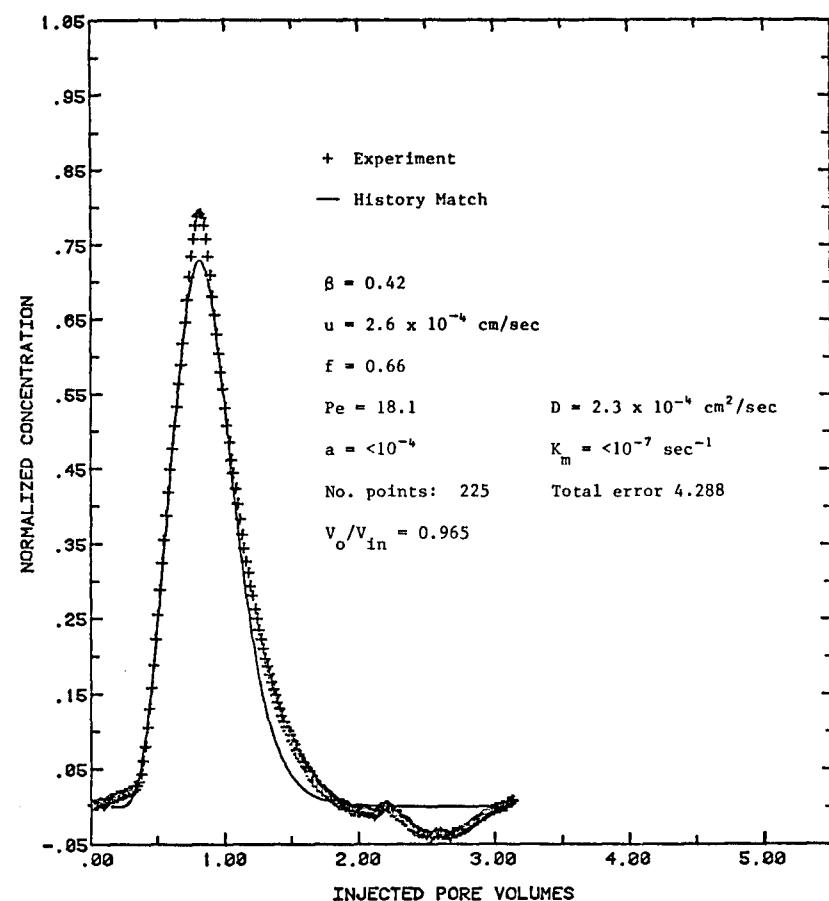


Fig. B.26 Experiment No. 26 Core: H-1  
Length: 16.2 cm Diameter: 3.81 cm  
Pore volume:  $33.7 \text{ cm}^3$  Porosity: 18.2%  
Air permeability: 40 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ -brine  
Dead volume:  $0.85 \text{ cm}^3$

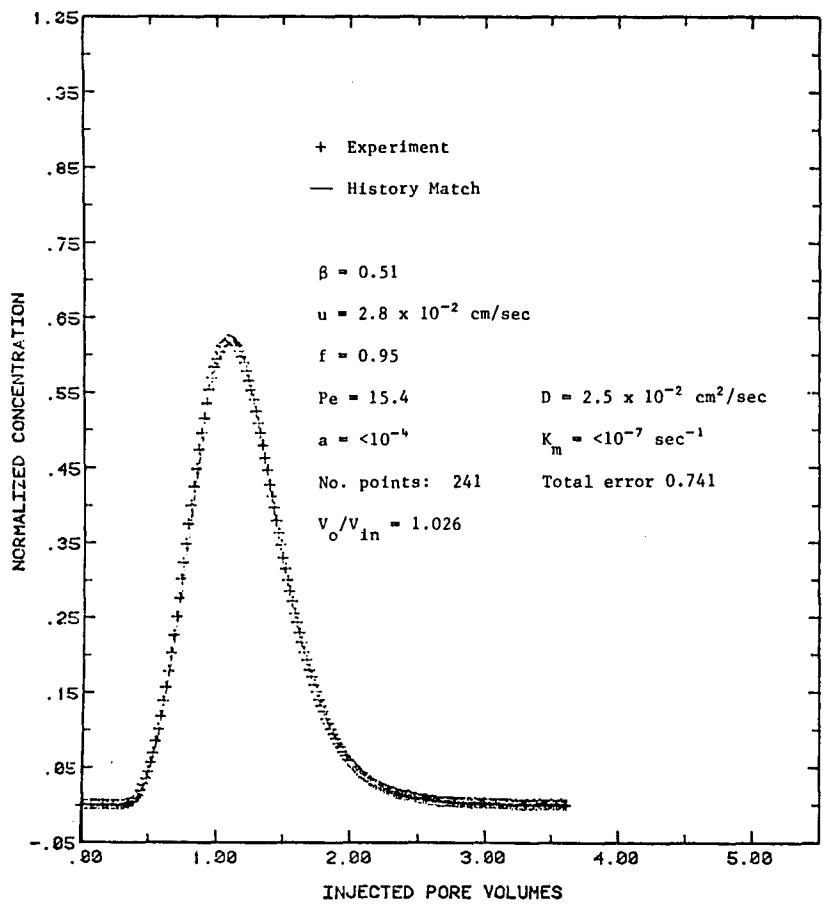


Fig. B.27 Experiment No. 27 Core: WW-2  
 Length: 13.7 cm Diameter: 1.27 cm  
 Pore volume:  $3.70 \text{ cm}^3$  Porosity: 21.3%  
 Air permeability: 90 md  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $0.575 \text{ cm}^3$

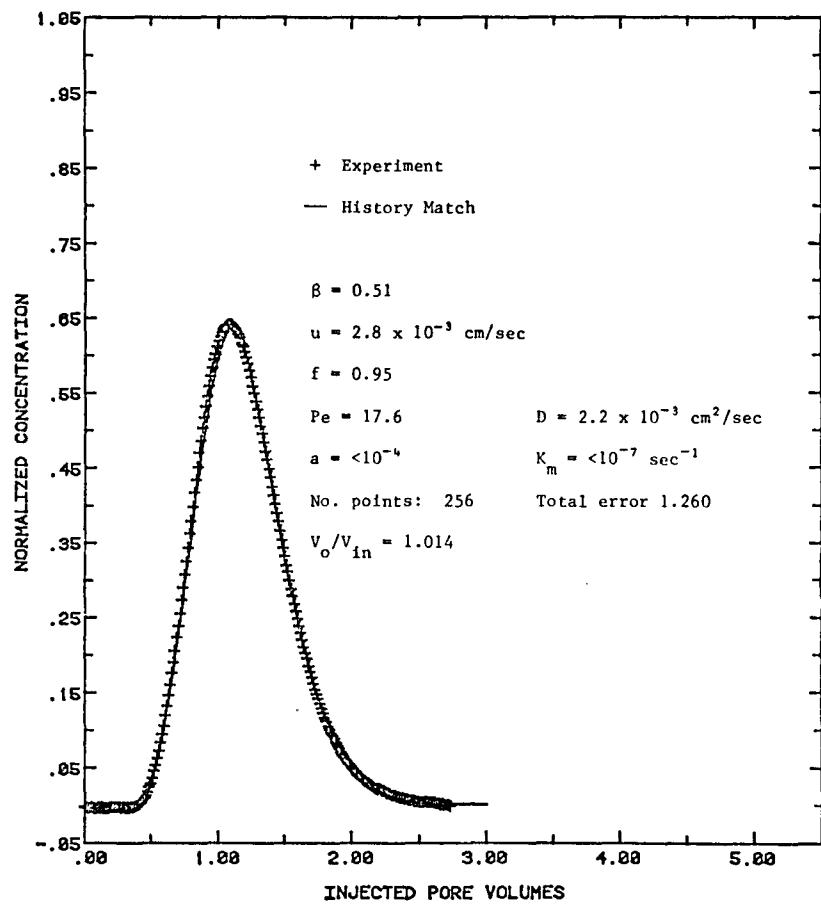


Fig. B.28 Experiment No. 28 Core: WW-2  
 Length: 13.7 cm Diameter: 1.27 cm  
 Pore volume:  $3.70 \text{ cm}^3$  Porosity: 21.3%  
 Air permeability: 90 md  
 Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
 Dead volume:  $0.575 \text{ cm}^3$

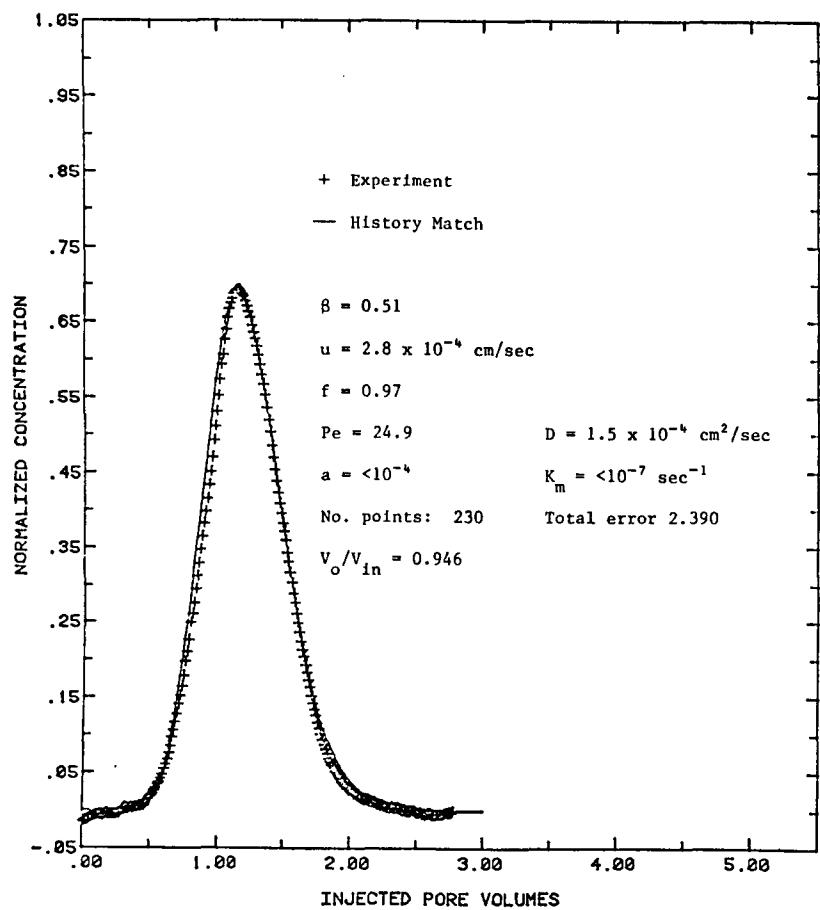


Fig. B.29 Experiment No. 29 Core: WW-2  
Length: 13.7 cm Diameter: 1.27 cm  
Pore volume:  $3.70 \text{ cm}^3$  Porosity: 21.3%  
Air permeability: 90 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$  brine  
Dead volume:  $0.575 \text{ cm}^3$

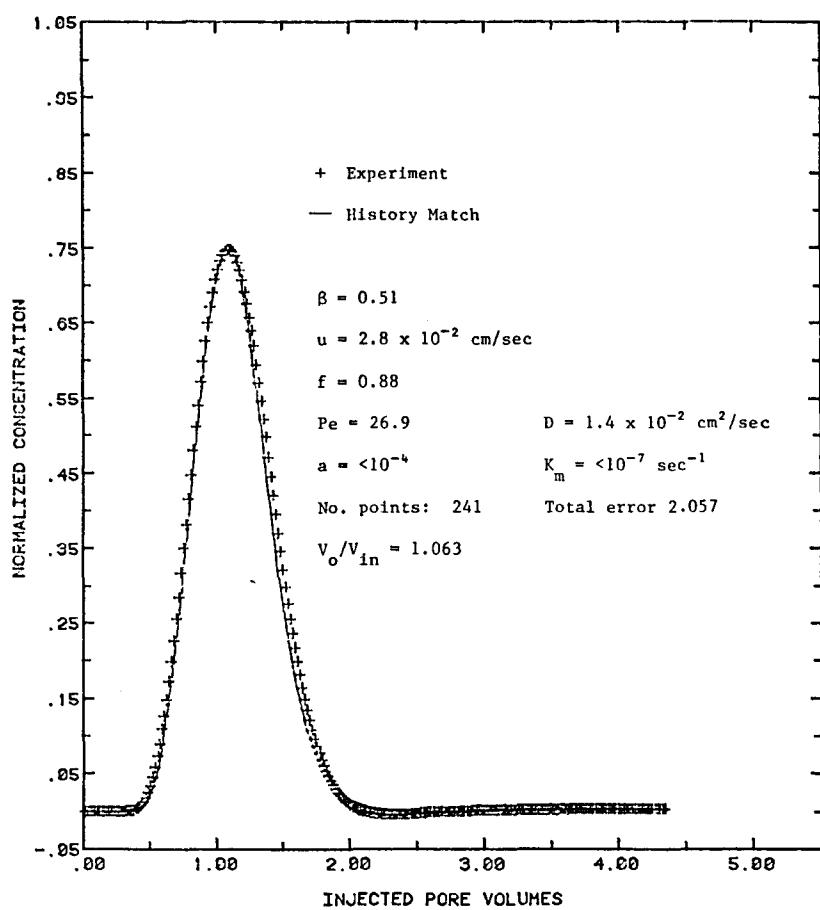


Fig. B.30 Experiment No. 30 Core: WW-2  
Length: 13.7 cm Diameter: 1.27 cm  
Pore volume:  $3.70 \text{ cm}^3$  Porosity: 21.3%  
Air permeability: 90 md  
Fluids:  $\text{C}_{10}/\text{C}_{11}$   
Dead volume:  $0.575 \text{ cm}^3$

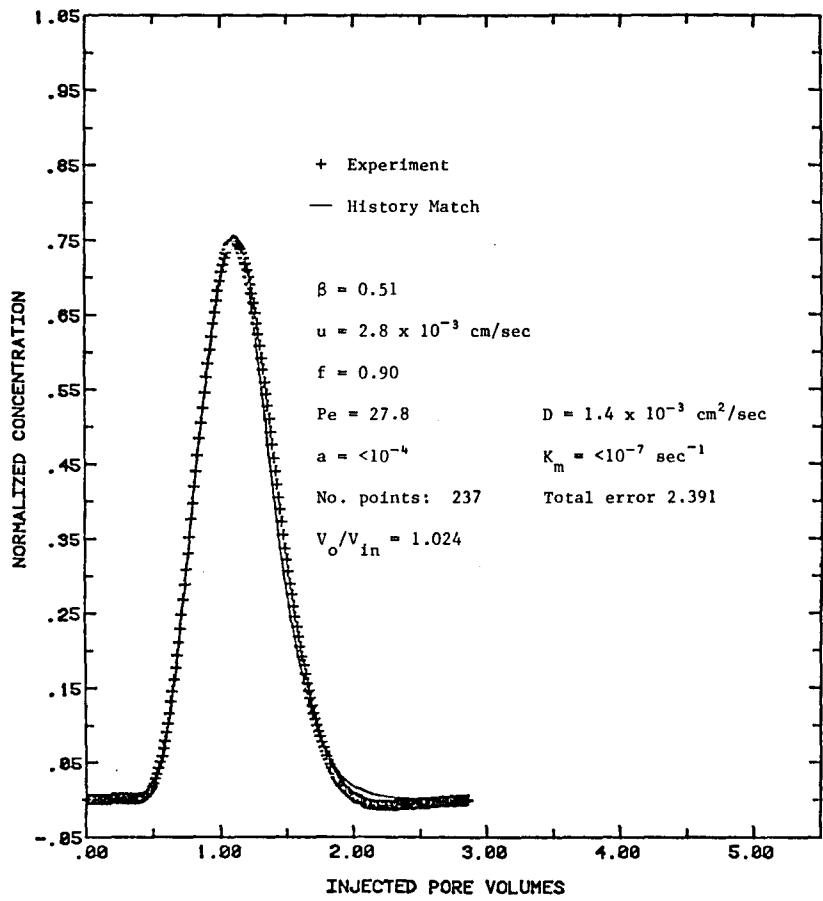


Fig. B.31   Experiment No. 31      Core: WW-2  
 Length: 13.7 cm      Diameter: 1.27 cm  
 Pore volume:  $3.70 \text{ cm}^3$       Porosity: 21.3%  
 Air permeability: 90 md  
 Fluids:  $C_{10}/C_{11}$   
 Dead volume:  $0.575 \text{ cm}^3$

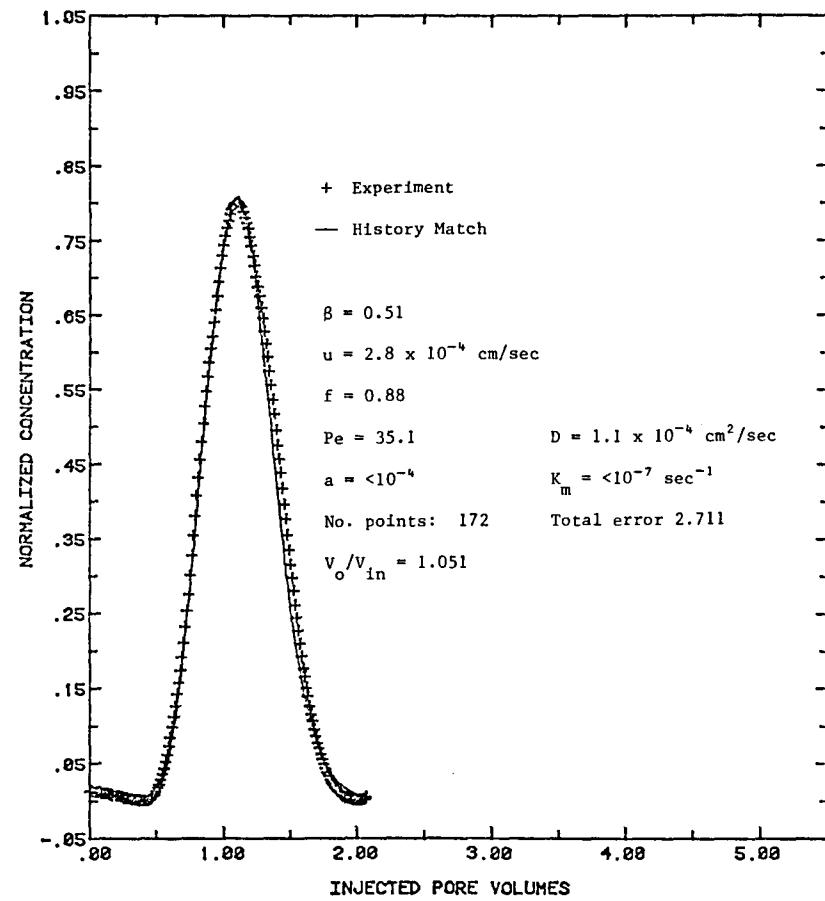


Fig. B.32   Experiment No. 32      Core: WW-2  
 Length: 13.7 cm      Diameter: 1.27 cm  
 Pore volume:  $3.70 \text{ cm}^3$       Porosity: 21.3%  
 Air permeability: 90 md  
 Fluids:  $C_{10}/C_{11}$   
 Dead volume:  $0.575 \text{ cm}^3$

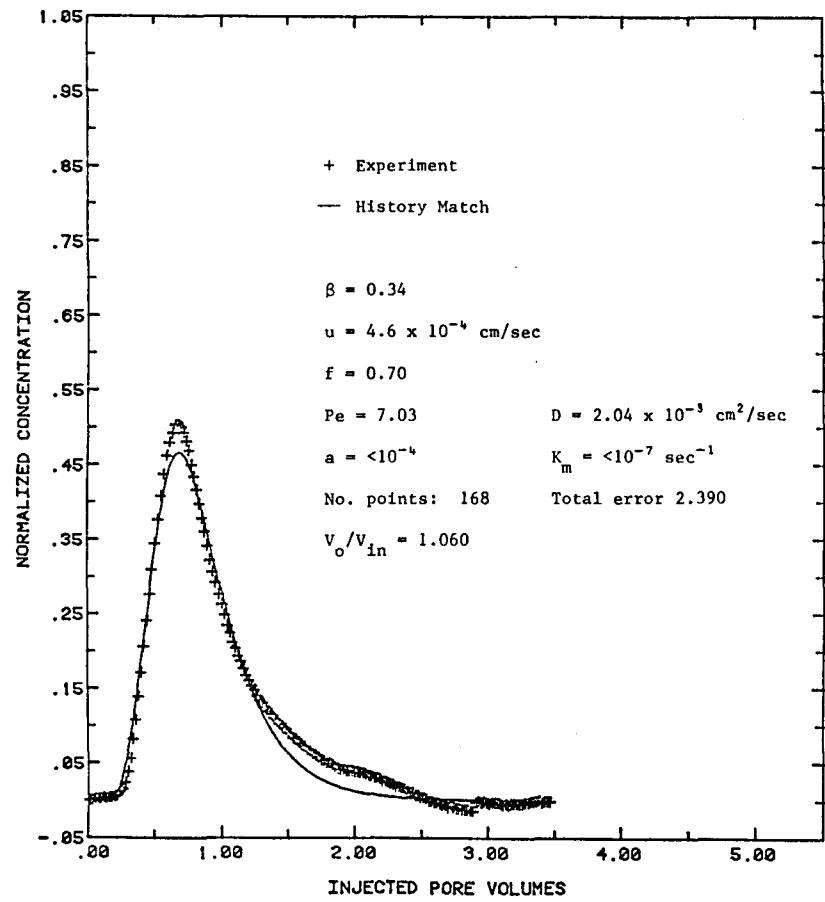


Fig. B.33 Experiment No. 33 Core: M-1  
Length: 31.5 cm Diameter: 1.59 cm  
Pore volume:  $5.67 \text{ cm}^3$  Porosity: 9.1%  
Air permeability: 6 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
Dead volume:  $0.358 \text{ cm}^3$

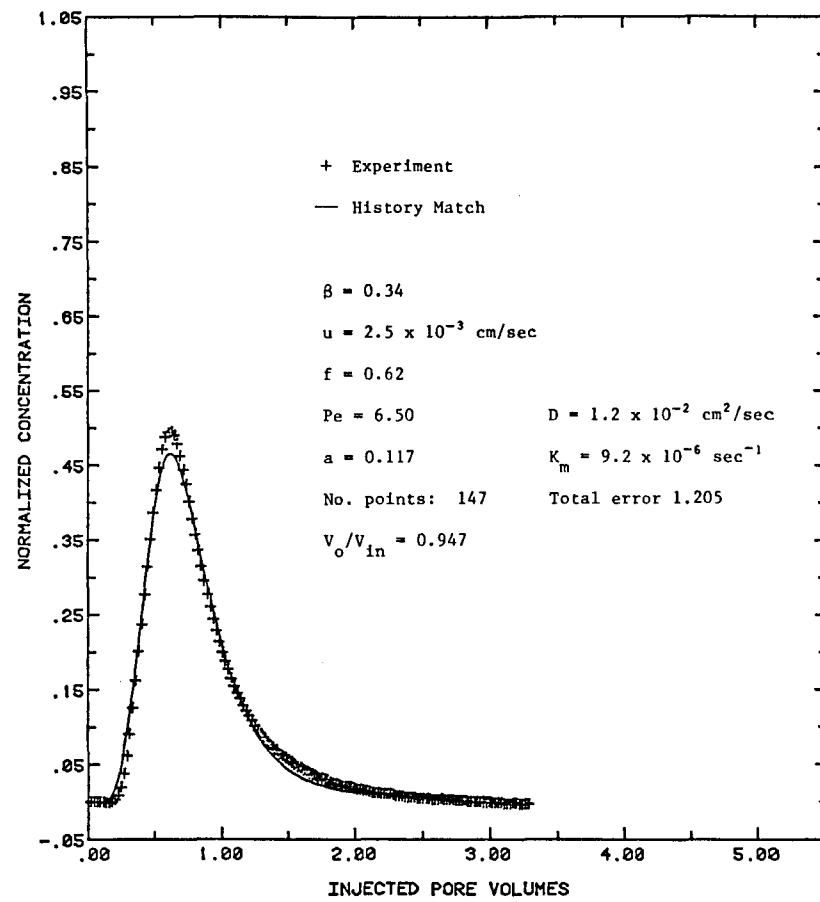


Fig. B.34 Experiment No. 34 Core: M-1  
Length: 31.5 cm Diameter: 1.39 cm  
Pore volume:  $5.67 \text{ cm}^3$  Porosity: 9.1%  
Air permeability: 6 md  
Fluids: 0.4%/0.52% sucrose in  $\text{Cl}^-$ brine  
Dead volume:  $0.358 \text{ cm}^3$

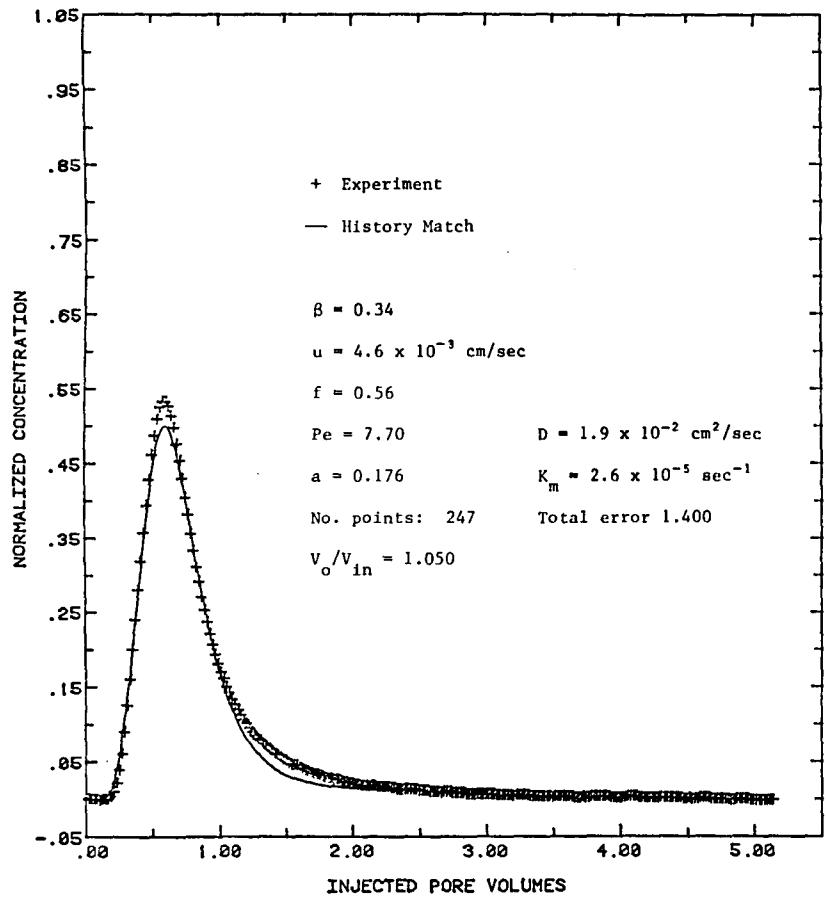


Fig. B.35 Experiment No. 35 Core: M-1  
 Length: 31.5 cm Diameter: 1.59 cm  
 Pore volume:  $5.67 \text{ cm}^3$  Porosity: 9.1%  
 Air permeability: 6 md  
 Fluids: 0.4%/0.52% sucrose in Cl<sup>-</sup>brine  
 Dead volume:  $0.358 \text{ cm}^3$

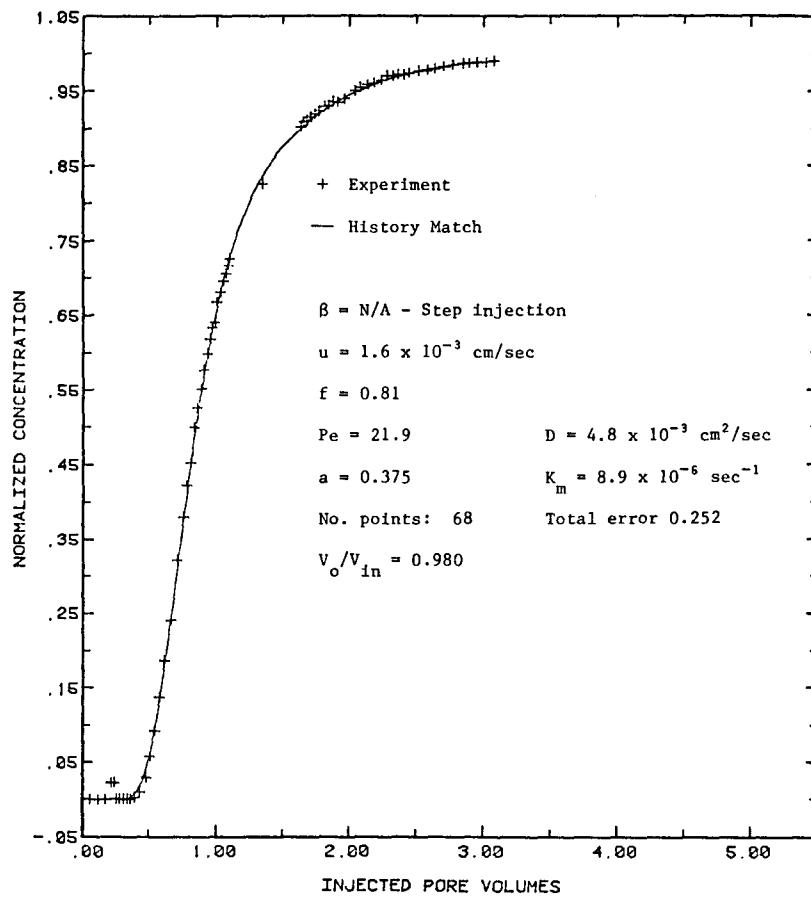


Fig. B.36 Experiment No. 36 Core: SAO  
 Length: 66.7 cm Diameter: 3.81 cm  
 Pore volume:  $235.16 \text{ cm}^3$  Porosity: 17.0%  
 Air permeability: 124 md  
 Fluids: ethylbenzene/ethylbutyrate  
 Dead volume:  $1.262 \text{ cm}^3$

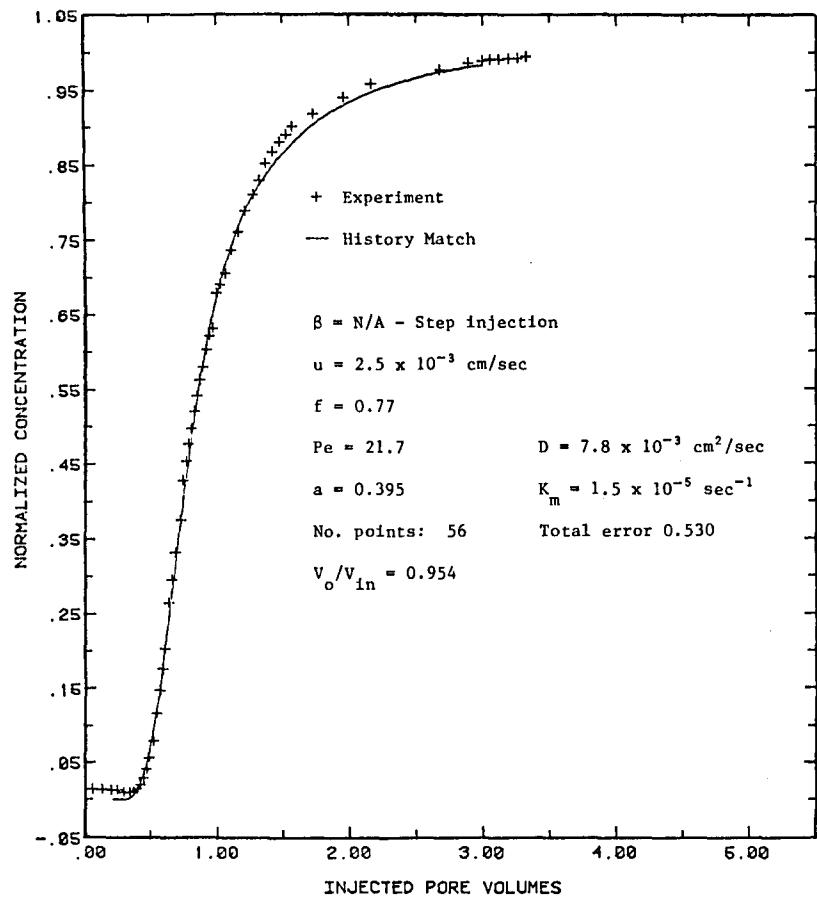


Fig. B.37 Experiment No. 37 Core: SA0  
Length: 66.7 cm Diameter: 3.81 cm  
Pore volume:  $235.16 \text{ cm}^3$  Porosity: 17.4%  
Air permeability: 124 md  
Fluids: ethylbenzene/ethylbutyrate  
Dead volume:  $1.262 \text{ cm}^3$

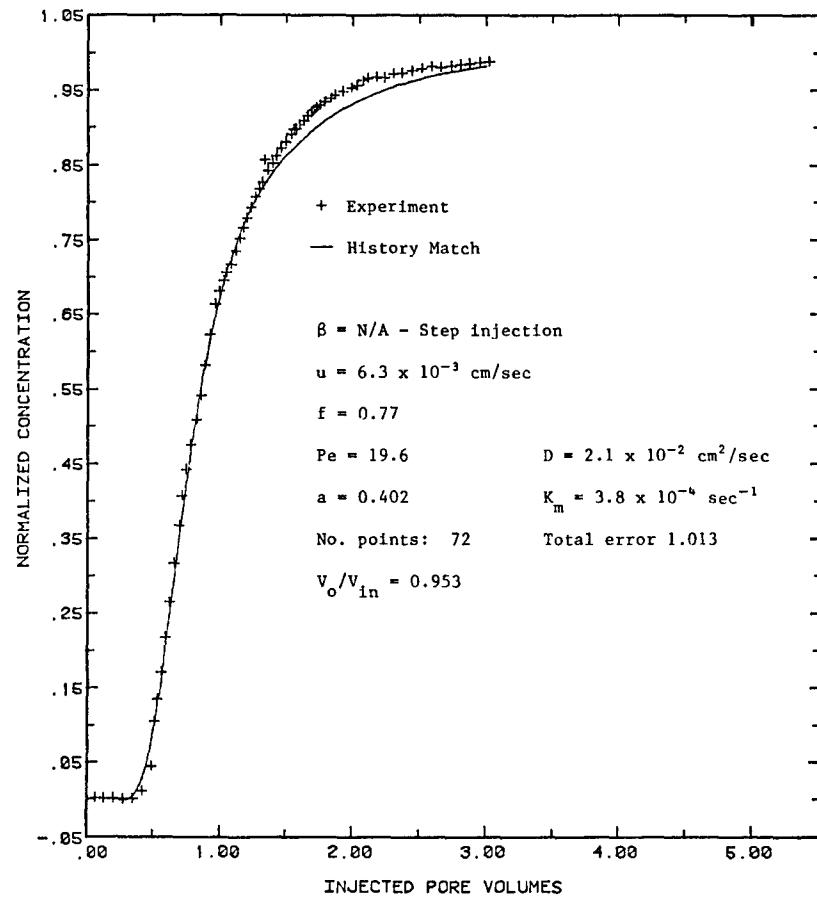


Fig. B.38 Experiment No. 38 Core: SA0  
Length: 66.7 cm Diameter: 3.81 cm  
Pore volume:  $235.16 \text{ cm}^3$  Porosity: 17.4%  
Air permeability: 124 md  
Fluids: ethylbenzene/ethylbutyrate  
Dead volume:  $1.262 \text{ cm}^3$